

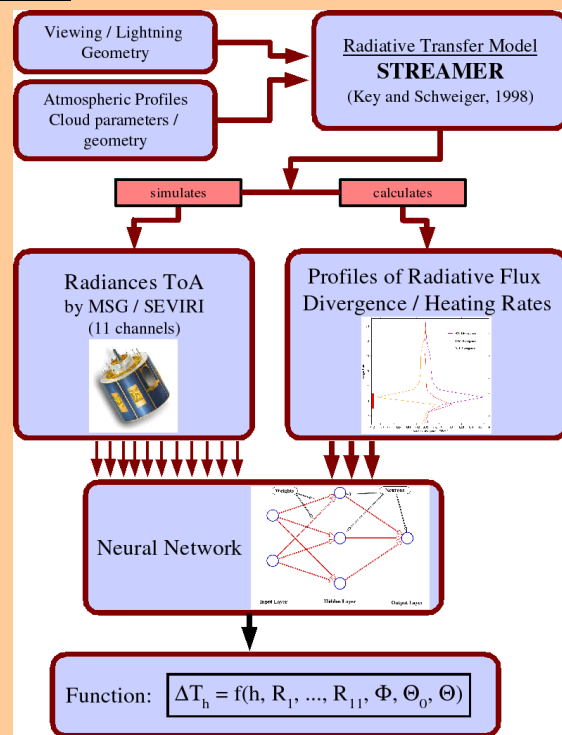
Remote Sensing of Radiative Heating Rates

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1. Why Radiative Heating Rates?

- Source term of Available Potential Energy (APE) (dominating on global scale)
- Important part of the atmosphere's engine
- APE and ΔAPE : functions of average values over pressure levels -> **Satellite usage necessary**
- MSG: high spatial and temporal resolution, 11 usable channels

2. Method



3. Data Set

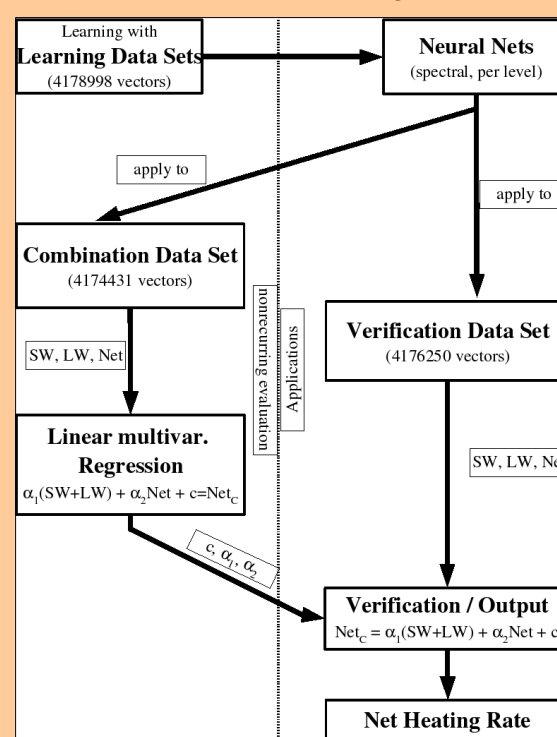
- Simulate Heating Rates (Shortwave, Longwave and Net) in three altitude levels and corresponding MSG radiances with Radiative Transfer Model Streamer
 - Varying 12 variables (surface, atmospheric profiles, cloud geometry and physics, sun geometry, viewing geometry)
→ total of 2934900 profiles per viewing geometry
 - Limitations:
 - Aerosols only as background
 - Emissivity of surface is constant with wavelength and surface type
 - Only single layer clouds
 - Use independent, random parts of dataset for
 - Training of Neural Networks
 - Verification
- Limited size due to computer capacity

4. Neural Network

- 9 Independent Networks for
 - SW, LW, Net Heating Rate
 - Low, Medium, High Layer
- Input: 12 channels (IR039 solar / IR)
- Output: 1 Heating rate per net
- 4-5 hidden layers,
- 12-15 neurons each

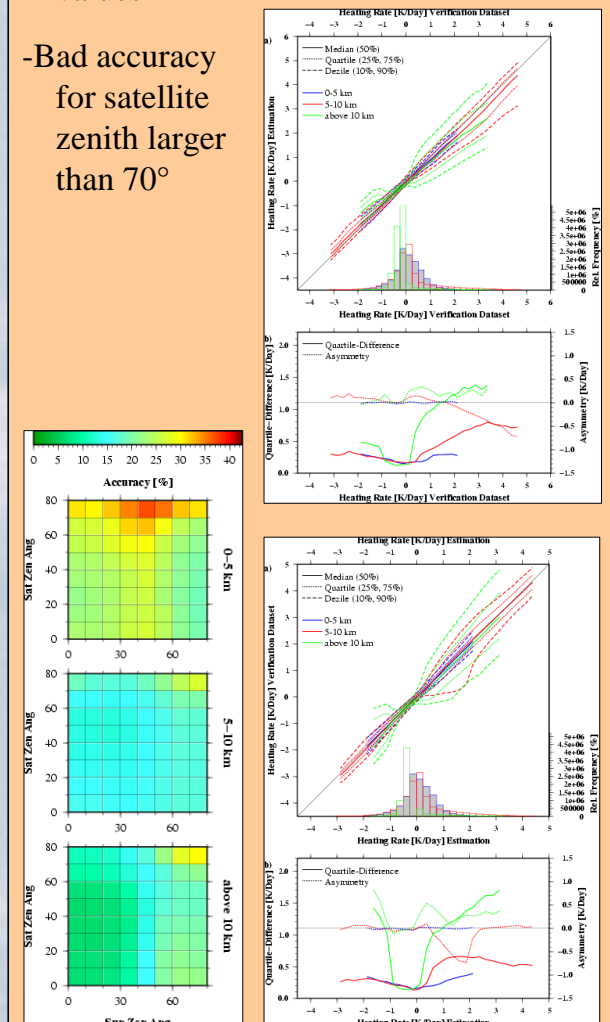
5. Combination of Models

- **Independent** Models can be combined
- Error Minimizing with Combination Data Set (Linear Regression)



6. Accuracy

- Total accuracy:
 - low: 0.23 K/Day (19.28%)
 - med: 0.32 K/Day (14.32%)
 - high: 0.17 K/Day (11.94%)
- Over-/underestimation of low/high values
- Bad accuracy for satellite zenith larger than 70°



7. Application

- Written in IDL
- Reads input data in CineSat - Format
- Current Version too slow for operational usage (16 min for full disc)
- Useful as climate application (wanted by SAF on Climate Monitoring)
- Combination with other products possible (e.g. latent heat)

